Review of Income and Wealth
Series 38, Number 1, March 1992

INTERSTATE INCOME INEQUALITY IN THE UNITED STATES: MEASUREMENT, MODELLING AND SOME CHARACTERISTICS

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Five points are made in this study. First, using a well-recommended measure, *inter*state income inequality is reported for each year from 1950 through 1989, and its very small magnitude is pointed out along with the U-shaped profile. Second, it is shown that a simple quadratic-form model fits the data extremely well. Third, inequality indices for 1977 and 1988 are recomputed after adjusting for interstate price-level variations, and large reductions in the indices, and a virtual disappearance of the increase in inequality after 1978, are noted. Fourth, a simple decomposition shows that income changes account for most of the inequality change in each decade. Last, states that have contributed most to inequality are identified.

I. INTRODUCTION

Regional and interstate income inequalities in the United States have understandably been of considerable interest to researchers and policy-makers. In particular, much interest and concern have been expressed in regard to the increasing trend in these inequalities during the last decade after over 40 years of virtually steady decline.[1]

The main purpose of this paper is to supplement existing work by elaborating on several aspects of interstate inequality in the U.S. during the past 40 years. A well-recommended measure of inequality is computed for each year, and the path of interstate inequality is modelled through a simple formulation that shows an extremely good fit even though it does not include any of the variables whose contribution to interstate inequality has been investigated by various scholars.[2] In addition, it is pointed out that the magnitude of interstate inequality is very small, both absolutely and relative to intrastate (and total) inequality. Also, a somewhat overlooked aspect is considered by exploring the sensitivity of the computed indices of inequality to adjustments for price-level (cost-of-living) variations across states. Two other characteristics of interstate inequality are discussed by (a) decomposing the inequality changes over each decade into the components due to changes in income and population, and (b) identifying states that have contributed most to inequality in selected years.

Note: Two anonymous referees of this *Review* gave several useful suggestions on an earlier version. The author is, however, responsible for all errors and deficiencies.

[1]See, for example, Coughlin and Mandelbaum (1988, 1989), Ray and Rittenoure (1987), and U.S. Bureau of Economic Analysis (1989a).

[2]The factors examined include the "Sun-Belt/Frost-Belt" dichotomy, differential growth rates of "coastal" and "interior" areas, "agricultural crisis" of the 1980s, changing energy prices, and federal spending and taxation patterns. See, besides others, Coughlin and Mandelbaum (1988, 1989).

II. Data, Measure of Inequality, and the Basic Results

The data are fairly standard and consist mainly of the U.S. Bureau of Economic Analysis (1989b, 1990) estimates of state personal income per capita and total personal income, the latter being used to calculate population. Continuous data on the 50 states (including Alaska and Hawaii) and D.C. are available from 1950, and the period studied extends through 1989.

Although there are many measures of income inequality, the one used is Bourguignon's (1979) L which, besides being computationally convenient, has many desirable properties. Bourguignon (1979, p. 912) has shown that this is the only (population-weighted) inequality measure that is additively decomposable, differentiable, symmetric, and homogeneous of degree zero in income, and satisfies the Pigou-Dalton criterion.[3] Therefore, it seems very good for measuring interstate (as well as intrastate) income inequality. In fact, Bourguignon (1979, p. 913) observed "That the inequality measure L has seldom been used in applied works on income distribution is somewhat surprising because it has very much to commend it."

The following expression for L can be used to represent inequality in personal income per capita across states

$$L = \sum_{i=1}^{51} p_i \ln (p_i/y_i), \tag{1}$$

where p_i and y_i are respectively the shares of state i in total population and total personal income and ln denotes natural logarithm.[4] Besides Bourguignon (1979), Theil (1967, pp. 125-127) and Kakwani (1980, pp. 88-90) have discussed several properties of the inequality index stated in equation (1). In particular, its lower bound is zero; the upper bound is not 1, but a value of 1 indicates high inequality.[5]

In Table 1 I present the values of L for each year from 1950 through 1989. Noting that the lower bound for the index is zero, and a value of 1 reflects high inequality, it is reasonable to say that all values of the index are very small. However, it is easily seen that while the index declined steadily from 0.024 in 1950 to 0.007 in 1978-79, it has been rising thereafter and reached 0.012 in 1989. Although the measure of inequality used in this work is different from those employed by other researchers, the broad scenario depicted in Table 1 is very similar to that set forth in other studies: a steady decline in interstate inequality until 1978-79 and a fairly continuous increase since then. Figure 1 contains a plot of the inequality index over time, and it is consistent with the picture suggested by Table 1 and by other studies.[6]

[3]While Bourguignon (1979) sets forth several desirable properties of L, Cowell (1988) describes three "bad" inequality measures that are decomposable, and points out difficulties with the decomposition of the widely-used Gini index.

[4]As Bourguignon (1979, p. 915) also points out, L can be obtained by interchanging the positions of p_i and y_i in Theil's well known entropy-based income-weighted index of inequality. Equivalently, L is the same as Theil's "populatation-weighted" index.

[5]For example, in a two-group situation, if one group has 80 percent of the total income and 20 percent of the total population, the inequality index will be 0.83; for a situation in which one group has 90 percent of income while containing 10 percent of the population, the index will be 1.76.

[6]Total income inequality and interstate inequality seem to have a similar pattern although the zero-order correlation between them over the period is low. Smolensky (1961) suggests one reason for the two having similar patterns. Several recent studies of total U.S. inequality include Shackett and Slottje (1987), Slottje (1989), Hayes *et al.* (1990), and Bishop, Formby and Smith (1991).

TABLE 1

INDICES OF INTERSTATE INCOME INEQUALITY (INEQ) IN THE UNITED STATES, 1950–89

Year	INEQ	Year	INEQ
1950	0.024	1970	0.012
1951	0.022	1971	0.011
1952	0.021	1972	0.010
1953	0.021	1973	0.009
1954	0.021	1974	0.008
1955	0.020	1975	0.008
1956	0.020	1976	0.008
1957	0.020	1977	0.008
1958	0.018	1978	0.007
1959	0.018	1979	0.007
1960	0.019	1980	0.008
1961	0.018	1981	0.008
1962	0.018	1982	0.008
1963	0.017	1983	0.009
1964	0.017	1984	0.009
1965	0.015	1985	0.010
1966	0.015	1986	0.010
1967	0.014	1987	0.011
1968	0.014	1988	0.012
1969	0.013	1989	0.012

Note: The index of inequality is Bourguignon's (1979) *L*. The indices are calculated from data on personal income per capita for 51 states (including D.C.). The earliest year for which 51-state data are available is 1950.

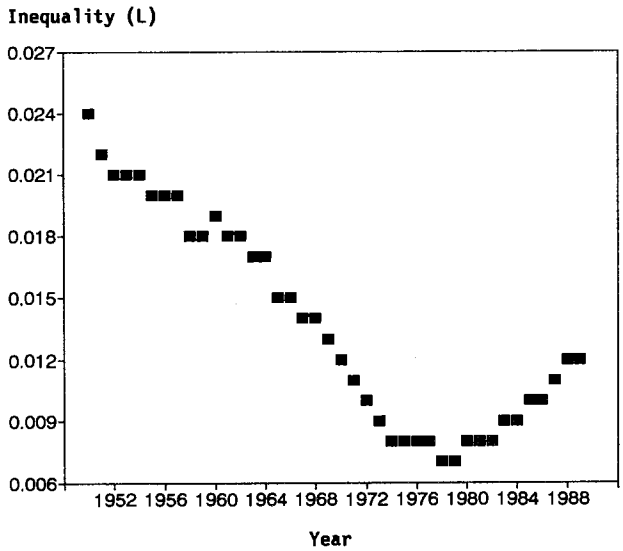

Figure 1. Plot of Interstate Income Inequality in the United States, 1950–89 (Based on Table 1)

It is obviously interesting to make an effort to model the inequality observed over this period. The plot in Figure 1 suggests that a quadratic equation in terms of "time" should fit the data well.[7] A simple model may, therefore, be represented by

$$\text{INEQ}_T = a + bT + cT^2 + u_T, \tag{2}$$

where INEQ is the index of inequality (L), T is the "time" variable, and u is the standard disturbance term.[8]

TABLE 2

ESTIMATED PARAMETERS OF REGRESSION OF INTERSTATE INEQUALITY (INEQ) ON LINEAR AND QUADRATIC TERMS OF TIME (T), 1950–89

	Parameter Estimate	t-Statistic
Constant term	2.577	32.31*
b (coefficient of T)	−1.069	−10.28*
c (coefficient of T^2)	0.144	6.68*
Regression $\bar{R}^2$: 0.90	Standard error of the regression: 0.163	

Note: Based on Table 1. To prevent the estimates from becoming too small, INEQ is measured in 100 units of L ($=100L$), and T is measured in units of 0.1 year, which means $T=$ (year−1949)/10.

*Statistically significant at least at the one percent level.

Table 2 contains estimates of equation (2). It is clear that fit of this simple model is extremely good, and would compare favorably, in terms of (adjusted) R^2 and standard error of the regression (SEE), with almost any elaborate model. It is also easy to see that the estimates represent quite faithfully, in a parametric form, the structure depicted in Figure 1.[9]

III. SENSITIVITY OF THE INEQUALITY INDEX TO ADJUSTMENT FOR PRICE-LEVEL VARIATIONS ACROSS STATES

It is evident that personal income data of the U.S. Bureau of Economic Analysis (BEA) for different states make no adjustment for price-level differences across states. However, although no established sources of information on interstate price-level variations seem to exist, price level ("cost of living") is not

[7]If T is treated as a proxy for the level of economic development in the U.S., equation (2) can be interpreted as a representation of Kuznets's (1955) hypothesis relative to the course of the *inter*state component of inequality in the United States.

[8]The time variable T and the inequality measure L have been slightly rescaled to prevent the estimated coefficients from becoming too small. The regression results are based on $\text{INEQ}=100L$ and $T=$(year−1949)/10. See also note in Table 2.

[9]It may be instructive to note the following estimates of equation (2) *without* the T-square term: $\text{INEQ}=2.176\ (28.30)-0.391T\ (-11.95)$, $\bar{R}^2=0.78$, SEE = 0.239. Although clearly inferior to the full quadratic, the linear version also does very well. Its good explanatory power could mislead one into the inference that interstate inequality shows a declining pattern over the entire period.

identical across states and the differences are unlikely to be random.[10] Casual observation suggests that the price level (cost of living) may be higher in states with higher personal income per capita and lower in those where per capita incomes are smaller. Such a positive covariance between personal income per capita and the price level would lead to an overstatement of income inequality across states if no adjustment for price-level variations is made.[11] It is useful, and perhaps important, to make some assessment of interstate inequality if personal income per capita in each state is adjusted for price-level variations across states and is expressed in a common set of prices. While the relevance of this aspect is obvious, it appears to have been overlooked in the literature, and the reason perhaps is the lack of price-level data for states.

The work by McMahon and Melton (1978) and McMahon (1988) is helpful in this context. By using the information on CPI for metropolitan areas, they provide estimates of price levels (cost of living) in respect of 48 states and D.C. for the year 1977 and all the 50 states and D.C. for the year 1988.[12] These estimates can be used to compute adjusted indices of ("real") interstate inequality, and one can see how much difference the adjustment makes and how the adjusted indices for 1977 and 1988 compare. Comparison of the corrected indices for 1977 and 1988 is especially useful since this is the period over which the conventional (unadjusted) measures show a steady increase.

The adjustment is fairly straightforward. One can define "real" personal income per capita for state i and year t as $(\text{PCPI}_{i,t})/(P_{i,t})$ where PCPI is BEA's ("nominal") personal income per capita and P is the price level (cost of living) for the relevant state and year. The index L can then be computed from the adjusted (real) personal income per capita.

In Table 3 I show the conventional and the adjusted values of L for 1977 and 1988. It is clear that the adjustment makes a big difference. The adjusted index for 1977 is smaller than the conventional measure by nearly 70 percent; for 1988, the adjustment reduces the index to 20 percent (one-fifth) of its original value. In fact, price-level adjustment seems to reduce the values of L to almost insignificant levels.[13] Moreover, the increase observed in the unadjusted indices over the 1980s, which has received considerable attention recently, is virtually eliminated by the adjustment. Of course, in view of the somewhat tentative nature

[10]U.S. Bureau of Labor Statistics (BLS) publishes information on the consumer price index (CPI) for metropolitan areas, but, as far as the author is aware, no state-level measures of CPI, or of any other price index, are available on a systematic basis. McMahon and Melton (1978) and McMahon (1988) discuss the status of the information on price-level measures for states.

[11]This problem is similar to that encountered in intercountry comparisons on the basis of dollar income measures derived from conventional exchange rates. The issue has received careful attention in the ongoing International Comparisons Project. For one fine description of the problem and the difficulties of a complete solution, see Kravis, Heston and Summers (1982). The difficulty, however, seems much more serious in the intercountry context than for interstate inequality in the United States.

[12]See the cited sources for details that underlie the estimates. Although there can always be a difference of opinion in regard to such exercises, the estimates appear reasonable. Bishop, Formby and Thistle (1989) also include price-level information by state, but they cover only the year 1979, and it is difficult to make a comparison of the adjusted inequality indices across any two years.

[13]It may be instructive to note the large change in L caused by the adjustment even though the simple correlation between BEA personal income per capita and the price level is modest (0.24 and 0.29 for 1977 and 1988).

of these price-level estimates, some caution is needed in drawing strong conclusions.[14]

The illustrative comparisons in Table 3, thus, suggest important caveats in regard to conventional measures of the magnitude of interstate inequality and, perhaps more significant, regarding the size of its increase during the 1980s.[15]

TABLE 3

INDICES OF INTERSTATE INCOME INEQUALITY WITHOUT AND WITH PRICE-LEVEL ADJUSTMENT, 1977 AND 1988

	1977[a]	1988[a]
Without price-level adjustment ("conventional")	0.0074	0.0120
With price-level adjustment	0.0024	0.0024

Note: The inequality index is *L*. Basic data on personal income are from the U.S. Bureau of Economic Analysis (1989b, 1990). Price-level data for 1977 are from McMahon and Melton (1978) and those for 1988 are from McMahon (1988).

[a]The indices for 1988 cover the 50 states and D.C., but those for 1977 cover 48 states and D.C., and exclude Alaska and Hawaii for which McMahon and Melton (1978) did not report price levels. Excluding Alaska and Hawaii, the numbers for 1988 are 0.0121 and 0.0029 respectively.

IV. SOME OTHER CHARACTERISTICS OF INTERSTATE INEQUALITY

It was pointed out in the preceding section that price-level adjustment causes a large reduction in the index of interstate inequality and makes it so small as to be a cause of only minor concern.

However, as mentioned in Section II, values of *L* listed in Table 1 for the 40-year period seem very small even without the price-level adjustment. Although "smallness" is a somewhat subjective notion, and one could conceivably treat the observed values of *L* as not being small despite their closeness to the lower bound of zero, it is possible to place interstate inequality in the broader context of overall income inequality in the U.S. and to see how large a fraction of the total it is. An additively decomposable measure is obviously useful for this purpose. In another study, Ram (1991) has prepared estimates of *L* for (total) interfamily inequality in the United States on the basis of *Current Population Survey* data pertaining to the income shares of (five) quintiles of families. The estimates for the period studied range from about 0.20 to 0.26.[16] The interstate

[14]Need for caution is suggested by several considerations. First, the price-level measure ("cost-of-living inflator") reported by Bishop, Formby and Thistle (1989, pp. 70–71) for 1979 leads to a 40 percent reduction in *L* (from 0.072 to 0.041) instead of the nearly 70 percent reduction for 1977 noted in Table 3. Second, McMahon and Melton (1978) did not report price levels for Alaska and Hawaii for 1977, but did include these in the numbers for 1988. Therefore, the two years are not strictly comparable in Table 3. As note *a* in Table 3 shows, if Alaska and Hawaii are excluded, one can discern a tiny increase from 1977 to 1988 even in the adjusted measures of inequality.

[15]As an aspect of the structure of *L*, it may be noted that exclusion of Alaska and Hawaii lowers (the unadjusted) *L* for 1977, but raises it slightly for 1988. Also, the price-level adjustment for 1988 has a larger effect when Alaska and Hawaii are included than when they are excluded.

[16]The "true" total inequality would be considerably larger because inequality within each quintile is not captured in these indices.

inequality is, therefore, of the order of 5 percent to 10 percent (one-twentieth to one-tenth) of the total income inequality. In other words, some 90 percent to 95 percent of income inequality in the U.S. is *intra*state, and that should perhaps be of much greater concern than interstate inequality.[17]

As an aside, it may be instructive to contrast the structure of inequality across and within states in the U.S. with the corresponding structure across and within countries in the international community. Although information on intracountry income inequalities is sketchy, and even measures of intercountry inequality have some weaknesses, it is evident that interstate inequality as a proportion of total inequality in the U.S. is much smaller than intercountry inequality as a proportion of what might be called total world income inequality: the former is around 0.05 to 0.10 (5 percent to 10 percent) while the latter is probably 0.60 to 0.70 (60 percent to 70 percent).[18] Of course, such a situation is to be expected; but it might provide a broader perspective for judging whether interstate inequality is "large" or "small."

Although one is naturally inclined to perceive changes in income inequality in terms of changes in income, it is well known that the structure of population changes can also have a significant effect on changes in inequality. Theil and Sorooshian (1979) provide a decomposition of the change in interstate income inequality, in terms of L (their J), from 1970 to 1977 into the components due to income changes and population changes. Berrebi and Silber (1987) report a similar decomposition of changes in interstate inequality (in terms of the Gini) during 1960–70 and 1970–80. Following the methodology of Theil and Sorooshian (1979), the decomposition of changes in interstate inequality for each of the four decades is reported in Table 4.[19] Two points may be noted from the results. First, these reaffirm the proposition that by far the largest component is due to income changes in all periods, and population changes are only a very small factor. Second, the pattern of decomposition is fairly stable and is essentially the same for periods of decreasing inequality (1950–59, 1959–69, and 1969–79) and increasing inequality (1979–89).

It may also be of some interest to see which states contribute most heavily to the observed inequality and whether there is a change in the pattern over time. It is obvious from equation (1) that the contribution of each state depends on (a) the divergence between its personal income per capita and the overall personal income per capita, which divergence is reflected in the ratio p_i/y_i, and (b) population of the state. The larger is the divergence between state and overall

[17]That interstate inequality is relatively small, even without the price-level adjustment, is also indicated by the consideration that the ratio of the minimum and the maximum per capita personal income across states is typically of the order of only 1:2.

[18]Remarks about the decomposition of world inequality are perhaps just a little more than a guess. Ram's (1992) estimate shows that the value of L for intercountry inequality in "real" GDP per capita is about 0.6. The "average" intracountry inequality may be of the order of 0.35 to 0.45 in terms of L. Thus, while the average intracountry inequality in the world may roughly be 1.5 to 2 times the mean intrastate inequality in the U.S., intercountry inequality is nearly 50 times larger than interstate inequality in the United States.

[19]Details of the procedural steps are stated by Theil and Sorooshian (1979). Additional information is available from the author.

TABLE 4

DECOMPOSITION OF CHANGES OVER DECADES IN INTERSTATE INEQUALITY IN THE U.S. INTO COMPONENTS DUE TO INCOME CHANGES AND POPULATION CHANGES, 1950-89

	Component due to income change[a]	Component due to population change[a]	Total change[a]
1950-1959	−0.0047	−0.0010	−0.0057
1959-1969	−0.0050	−0.0002	−0.0052
1969-1979	−0.0058	+0.0001	−0.0057
1979-1989	+0.0050	−0.0001	+0.0049

Note: The index of inequality is Bourguignon's (1979) L, with values of 0.0238, 0.0181, 0.0129, 0.0072, and 0.0121 for 1950, 1959, 1969, 1979 and 1989 respectively.

[a]Probably due to the changes being "large," the two components do not add to the total change in some cases, and the components have been rescaled to add to the actual total change. The broad picture is not sensitive to such rescaling.

personal income per capita, or larger is its population, the larger would be its contribution.[20]

In Table 5 I show, for 1950, 1959, 1969, 1979 and 1989, six most "influential" states in terms of their impact on interstate inequality; three are those with income

TABLE 5

STATES CONTRIBUTING THE LARGEST COMPONENTS TO INTERSTATE INEQUALITY IN THE U.S., SELECTED YEARS

1950	1959	1969	1979	1989
		States with above-average income		
New York	California	New York	California	California
(83)	(101)	(127)	(220)	(112)
California	New York	California	Illinois	New York
(63)	(101)	(124)	(78)	(93)
Illinois	Illinois	Illinois	New York	New Jersey
(47)	(56)	(55)	(69)	(78)
		States with below-average income		
Alabama	North Carolina	Texas	North Carolina	Texas
(42)	(47)	(53)	(77)	(71)
Mississippi	Mississippi	North Carolina	Alabama	Louisiana
(40)	(38)	(46)	(59)	(43)
North Carolina	Alabama	Alabama	Georgia	Mississippi
(37)	(37)	(44)	(57)	(34)

Note: Six states are listed for each year, three in each category. The numbers in parentheses indicate the component attributable to the state as a percentage of the total (observed) inequality. Recall that numbers for the above-average states have negative signs.

[20]Since p_i/y_i will be less than unity (1) for states with above-average income and greater than unity for states with below-average income, right hand side of (1) will consist of both negative and positive terms. Although the sum (L) will be positive (except for a perfectly equal distribution), one may consider the absolute size of each term as reflecting the contribution of the state to interstate inequality.

below average and three with above-average income.[21] As may be expected, New York and California from the above-average group and Alabama and Mississippi from the below-average group show up at or near the "top" in each year. Moreover, despite some changes, the broad pattern appears fairly stable over the 40-year period.[22]

V. Concluding Remarks

Perhaps the most significant aspects of this work consist of (a) placing interstate inequality in a broader perspective and suggesting that its magnitude has been very small both absolutely and relative to total inequality in the U.S., and (b) providing illustrative computations of interstate income inequality for 1977 and 1988 after adjusting for price-level variations, and showing large reductions in the conventional indices of inequality for both years and a virtual disappearance of the widely-discussed increase in inequality since the late 1970s. The simple modelling of the course of interstate inequality in terms of a quadratic of time also seems interesting because of the extremely good fit observed and the possibility of a somewhat misleading position being inferred from the restricted linear version that too does very well. Use of the rather well-recommended decomposable L may be of some advantage at least because the measure is different from those typically employed. The reported decompositions indicate a generally stable pattern in the components of inequality changes that are attributable to changes in income and in population, and the same is true of the identity of states that contribute most heavily to the conventionally measured interstate inequality.

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[21]The ease of such decompositions is one positive feature of L.

[22]The position summarized in Table 5 is obviously very compact. Complete ordering for each year is available from the author.

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